Methodology-driven use of automated support in business process re-engineering

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Abstract:
A description is offered of a 3-month pilot project to model and re-engineer an internal business unit of a major multinational firm using Enterprise Analyzer, a methodology and supporting group software tool for modeling and analyzing business processes. The methodology combines collaborative model building with creative problem reframing to enable multilevel, cross-functional business teams to quickly examine and redesign business processes. The tools developed for this project extend the capabilities of existing electronic meeting system technology to help groups build complex representations of their organization. The results suggest that the methodology and supporting tools can be effectively applied to re-engineer business processes, but also suggest the need for better ways to help groups accept innovative ideas. Many innovative ideas were generated, but few made it past the participants' evaluation and into the project's final recommendations.

Full Text:

Many organizations continue to use standard operating procedures and work processes that were designed or evolved in previous eras and environments. The result can be long cycle times, low quality, high inventories, and a generally poor response to customer needs[4, 7]. Business process re-engineering is radical redesign to simplify

work and to improve service and quality. Re-engineering involves reevaluating the entire business process, analyzing the interrelationships among business units, and identifying changes that would eliminate redundant processes and create more efficient and effective units.

The purpose of this article is to present the development and evaluation of one methodology for business process re-engineering. This methodology leverages information technology via Electronic Meeting Systems (EMS)[17] to improve the productivity of groups by providing a communication and information infrastructure, and the opportunity to use more structured group processes and task analysis techniques. We present here a case study in which a re-engineering team in a major multinational firm used an EMS-based methodology to analyze business processes and develop proposals for change.

BUSINESS PROCESS RE-ENGINEERING

Re-engineering has emerged as a means of increasing competitiveness in the 1990s, although its concepts have been advocated for years. In general, re-engineering starts by developing a business process model of how the activities currently function. This model is then examined to find new, innovative approaches to the business process that can produce dramatic benefits.

The core idea behind re-engineering is to develop and implement a set of radical, revolutionary ideas that will dramatically improve performance. In contrast, other approaches such as total quality management (TQM) or continuous process improvement strive to find areas for incremental, evolutionary improvements. For example, suppose you operate a package delivery service in a large city whose delivery personnel use tricycles. Your objective is to increase the speed of delivery. Incremental improvements (prompted by TQM, for example) might lead to the idea of building racing tricycles with bigger wheels and a swept-back design, or the idea of equiping drivers with special clothing to reduce wind resistance. Radical improvements (prompted by re-engineering) might suggest moving from tricycles to bicycles or even roller blades. Of course, even with enthusiastic participation, it may not be easy to make the change, because drivers need to be retrained and may require quite a different set of skills. The best tricyclist may not be the best bicyclist or even a passable skater.

Hammer[7] develops several principles for redesigning organizational work flows and standard procedures. These principles focus on empowering lower-level employees, distributing information collection and processing in the organization, and integrating information up the organizational hierarchy. Davenport and Short[4] also provide redesign principles, but, more importantly, provide a methodology for the overall re-engineering effort. This methodology involves defining business objectives, identifying processes to be redesigned, understanding existing processes, identifying IT levers, and building a prototype of the redesigned processes.

As companies scramble to understand how to re-engineer, some guidance is available from the published descriptions of re-engineering experiences[7]. However, since few formal studies have been documented, we do not have a detailed, validated model for re-engineering. We do, however, have a reasonable understanding of the problem. Many current business processes were designed to fit a business environment that no longer exists[4, 7]. Processes are legacies of scientific management[19] as practiced in the efficiency-minded 1950s: processes were separated into narrow "small" tasks that could be performed by less skilled workers with little responsibility or authority, while decisions were made by supposedly higher-skilled, more trusted managers and professionals. The goal of re-engineering is to use more modern management approaches and information technology to redesign the business to fit today's (and tomorrow's) environment.

Most current approaches to re-engineering are primarily "low tech" or manual processes that use sequential interviews or traditional verbal group meeting processes to develop the business model and identify opportunities for improvement. It can take months or even years for analysts to interview everyone involved with a process, validate the model, and finalize the process improvement data[1, 12, 13]. And, of course, traditional group processes are fraught with difficulty[17]. While these approaches assist business process re-engineering teams, there is ample room for improvement.

While there may be a general model for re-engineering, implementation must be customized and adapted to the specific needs and goals of each organization. The specific information modeled for each process, person, and information flow, the focus of model analysis, and the degree of prototyping new processes will vary from organization to organization.

The number and variety of stakeholders associated with a process dictate the level and style of communication required. The organization's handling of previous change efforts will also influence the employees' expectations

about management's acceptance of their suggestions. Technology for efficiently recording, organizing, and reviewing the contributions to the project should be extremely valuable.

THE ENTERPRISE ANALYZER APPROACH

The Enterprise Analyzer (EA) approach assists a group in identifying high-level business processes, decomposing these processes, and establishing information flows among the processes and other information sources[2]. It builds on prior electronic meeting systems (EMS) research to improve the performance of business teams[3, 5, 17]. EMS are information technology-based group meeting environments that provide a networked computer workstation to each group member. EMS enable groups to meet face-to-face with computer-mediated electronic communication used to supplement or replace verbal communication and decision modeling software used to improve analysis[5, 17]. There are at least three distinct styles of electronically supported meetings that blend different amounts of electronic and verbal interaction and facilitator intervention: chauffeured (participants interact verbally), supported (participants interact verbally and electronically), and interactive (participants interact electronically)[17].

Field studies using the EMS technology have reported significant reductions in the time required to complete projects (e.g., more than 50 percent reported in [17]). Laboratory studies have found it to be particularly useful for creativity tasks where teams are asked to generate new ideas (a fourfold increase in the number of high-quality ideas:[6]).

STEPS IN THE ENTERPRISE ANALYZER APPROACH

PREPARATION

Our approach includes four basic steps (see Table 1). The first step is preparation. In this step, the objective is to establish a climate for change within the organization. Both senior management and the line employees must understand the need for change and be committed to making the change.

Whenever no single person understands the whole system, it becomes important to build a cross-functional team that includes representatives from all functions within the business system to be re-engineered[9]. The key stakeholders from organizations that are suppliers or customers of the system should be included in the re-engineering team as they may have insights unavailable to those within the system. The objectives and scope of the project must be clear so that those assigned to the teams understand their mission.

ENTERPRISE MODELING

The objective of the second step, enterprise modeling, is for all members to gain an understanding of the current processes, since stakeholders may have conflicting assumptions in their views of the operations. First, team members identify and clarify the overall problems and issues, the goals, mission, and critical success factors of the enterprise, and the fundamental assumptions about how the enterprise should function. It is important to discuss and come to consensus on pivotal issues. Next, the team develops a process model that reflects what is currently done, who does it, and what information is shared among the processes. Documenting the current situation, via building a model of the business system, is a challenging and nontrivial exercise. The objective of model building is as much to help participants learn how the current system actually works as it is to produce a complete model.

REDESIGN

The essence of re-engineering is changing (1) what gets done, (2) who does it, and (3) what information is exchanged among processes, people, and organizations. Each of these three questions may identify potential re-engineering opportunities. Thus, the third step is redesign in order to find a set of radical improvements. Both "soft" and "hard" thinking (as defined by von Oech[22]) are used to develop a set of proposals for change because they are complementary; they encourage different types of ideas.

The objective of soft thinking is to encourage individuals to generate unconventional ideas. Soft thinking is fuzzy, ambiguous, playful, paradoxical, and not logical. It involves lateral thinking, approaching the issues from new and unusual directions. Von Oech[21, 22] provides many soft thinking techniques, two of which we have adapted for re-engineering: metaphorical thinking and what-if games. Metaphorical thinking asks participants to describe the current and desired state of the business system using figures of speech (e.g., "The company is like a jumping bean on a hot skillet"), while what-if games ask participants to challenge basic assumptions about the business. We use a

series of exercises and rules designed to promote soft thinking solutions to find similarities, patterns, and connections among apparently unrelated things.

Formal analysis techniques, while useful, are not designed to promote creativity. They are "hard" thinking as defined by von Oech[22]: logical, reasonable, focused, analytical, and based in reality. With this approach, we provide a series of formal analysis techniques and rules designed to identify inefficiencies in the current process flow. Formally modeling and analyzing the processes, people's involvements, and information flows are one aspect of re-engineering. Can processes be improved, eliminated, or off-loaded to someone else? Can we reduce the number of people involved with a process, the number of processes a person performs, or the number of organizations for whom the person performs a process? Can we reduce the information flows by combining processes or reassigning job responsibilities? After a large set of ideas has been generated, the next step is to organize, filter, and select ideas that will be refined into specific change proposals.

IMPLEMENTATION

The fourth and final step is implementation. A set of proposals is selected for immediate implementation, thus triggering actions to introduce changes and monitor the results. Re-engineering proposals may be quite radical and not unequivocally destined for success, particularly if the people who must implement them lack critical skills, aptitudes, and/or knowledge. While it is difficult to phase in radical change gradually[7], the redesigned processes can, and should, be prototyped. A small pilot project should be used to test the ideas before the company commits on a grand scale.

ENTERPRISE ANALYZER ARCHITECTURE

Our approach involves the blending of human and technical resources. The first is the client's re-engineering team, typically ranging from 8 to 20 people, drawn from all levels of the organization, as well as members from outside organizations.

The second resource is an analyst team responsible for assisting, coaching, and supporting the re-engineering team during the project. This team includes a facilitator as well as a technical support person. The facilitator is responsible for training participants on the re-engineering process, and guiding the team through use of the automated tools. Technical support is responsible for maintaining the software, operating some of the tools, and providing additional assistance as required.

The third resource is an electronic meeting room that enables the teams to use automated support. This facility provides a computer workstation to each team member to permit anonymous electronic communication among team members and to enable each member to work in parallel on the task. The room also provides a large screen video projection system so that team members can also use the computer system as an electronic blackboard to support verbal discussion of key issues.

The fourth resource is the knowledge repository used to store the enterprise model and the software to build and maintain it. The general structure of the Enterprise Analyzer software architecture can be described with a series of concentric circles and arcs. At the core of the architecture is the repository. The Model Object Editor, Queries, and Reports interact directly with the repository. The Translation Utilities function as Application Program Interfaces for the GroupSystems' tools and the other tools that have been created to support Enterprise Analyzer. We describe the software components below.

REPOSITORY

The centralized repository follows the AD/Cycle approach; it adds some object-oriented features to an entity relationship model[14, 15]. Basic tenets of our methodology imposed three principal requirements for the design of the repository. First, the client organization must be able to create its own metamodel, such as defining a requirements language. Second, all participants must have concurrent access to the data in the repository. Third, the repository must have a means to easily import and export data to and from existing computerized systems, previous reports, studies, system documentation, and work done by participants between sessions[18].

We chose commercial database software to implement the repository since a CASE tool was unlikely to meet all of our requirements. Commercial CASE tools typically use a project dictionary to store process models via a combination of unstructured narratives and a predefined structure. Furthermore, few CASE tools allow user groups to have concurrent access to the repository, or provide an easy import/export facility.

The basic metamodel includes entities such as processes, goals, and relationships but can be extended to include any entities, attributes, and relationships that are specific to the organization. The repository starts with a simple set of metadata, such as the dictionary, then lists all of the Entity-Relationship-Entity combinations that are valid, and catalogs information that defines the menus, directories, and programs used to maintain the entity and **relationship instance** records. For example, the catalog would include the model object editor program name used to update a process description, or a report program used to generate a specific completeness and consistency report. Entity records describe individual entity instances and their attributes. Relationship records will document or describe the relationship between two entity instances and are either implicit or explicit. Implicit relationships are derived by programs to minimize any redundant or repetitive work that would make poor use of the participants' time during the meeting. Whenever entities are described with a hierarchical numbering scheme, EA automatically generates relationship records, for example, process 3.2.1 can be assumed to be a decomposition of process 3.2. The group can also enter relationships explicitly by using the Enterprise Matrix or a model object editor program.

MODEL OBJECT EDITOR

One of the first activities after the metamodel has been defined is to create an editor program for each object type defined in the model. This editor program is used by the participants to add and update records defining specific instances of the object type, such as process "3.2.1." Participants can also quickly view a list of the processes that are already defined so they add fewer redundant process descriptions. Participants are also able to navigate through the model from object type to object type. For example, if the client team feels that it is helpful to examine processes and job descriptions alternately, a menu option can be added to the object editor programs for processes which allows the participant to switch to job descriptions and vice versa.

TRANSLATION UTILITIES

Translation utilities allow data sharing between the repository and the other software (e.g., GroupSystems) used in the project, When information is gathered using GroupSystems tools, such as Idea Organizer, the same tool may be used to gather goals, critical success factors, high-level processes, or any other type of object. Each object type may be defined in the repository's metamodel differently. The translation utilities are used to convert the standard output from the tool into a format that can be read by the repository's data import program. As a result there might be three different translation utilities that all take input from Idea Organizer and create output for a different object type defined in the repository.

In addition, these utilities afford the opportunity to append audit information such as the date, time, location, group, or meeting number. Most translations required to generate output from the repository can be done with the repository's query language and saved as a report program for repeated execution and/or customization.

GROUPSYSTEMS TOOLKIT

GroupSystems is an example of an EMS designed to support large group meeting at the same time in the same location. Each GroupSystems tool was initially designed to support one of four types of group activity. The first category, idea generation and brainstorming, involves the development and exploration of issues relevant to the task. The second category, idea organization, involves synthesizing, structuring, and organizing ideas into specific alternatives, which may follow the generation of ideas; if a group has previously discussed an issue, a meeting may begin with idea organization without idea generation. Tools in the third category, prioritizing, support the individual members in evaluating alternatives. The final category contains special-purpose tools that provide formal methodologies to support policy development and evaluation (e.g., stakeholder analysis), and a group text editing tool. See Nunamaker et al.[17] for a description of the GroupSystems tools.

ENTERPRISE MATRIX

Enterprise Matrix (EM) represents a family of matrix tools designed to allow a group, working in parallel, to establish the relationships between any two sets of objects (see figure 1)[8]. (Figure 1 omitted) One use of EM might be to establish the relationships among processes and organizations. In this case, Enterprise Matrix uses, as input, the process names as one axis of the matrix and organization names as the other axis. The list of allowable values for the relationship between a process instance and an organization instance is defined by the project leader and refined by the group. The relationship is represented by the value of a cell (the intersection of a row and a column).

GRAPHICAL BROWSER

The Graphical Browser (GB) can use any relationship records kept in the repository to display portions of the model graphically[20]. It is typically used to generate graphical displays of the data gathered using Enterprise Matrix. The resulting drawing can be a structure that is as simple as a tree or as complex as a network structure. Users can view the descriptions that exist in the repository for any particular object by moving the cursor over the object and selecting "description" from a menu. GB also isolates orphan nodes, to help analyze the model for completeness. The relationship labels may be optionally displayed on the connecting arcs. The user can "zoom out" to see the entire structure of the network, or zoom in to concentrate on a portion of the drawing. Drawings can be linked together to let the user jump from a "parent" drawing to "child" drawings and back. A single process is exploded into a tree of subprocesses in the child drawing. GB is used to display objects and relationships already in the model.

CASE STUDY

This section presents the results of using the EA approach with one organization. We preface the case description with the basic research design and some background on the organization.

RESEARCH DESIGN

The research design follows the system development research methodology advocated by Nunamaker et al.[6]. This approach holds that systems development is an evolutionary process and the experiences of developing and evaluating the system often lead to further enhancements to the system. The tools in EA were designed and implemented as a phase within this research methodology. The system was then used in the pilot project to support procedures developed by the researchers. A case study was used to evaluate both the system and the Enterprise Analyzer methodology.

To develop a well-rounded perspective of the case, data were collected from six sources to build a chain of evidence and to permit triangulation over methods and time. Given the nature of research questions and the use of a case study methodology, most of the data sources were qualitative. First, the behavior and actions of the group members were observed and recorded by at least one researcher during the meetings. Second, system logs recorded all keystrokes at all workstations, providing complete transcripts of all electronic comments made during the meetings. Third, questionnaires were completed anonymously by participants at the end of the study. The questionnaire items focused on evaluating the methodology and the tools used to support the methodology. Fourth, participants' opinions on a range of open-ended questions were surveyed during the middle of the study and at the end. Fifth, extensive interviews were conducted with the project leaders during the project and after it concluded. These interviews continued several months after the project (i.e., after the organizations had begun using the results from the re-engineering effort) in order to gain a sense of the lasting impacts. The interviews attempted to get participants to describe "what worked and what didn't work?" by reflecting on different aspects of the project and explaining how it differed from previous attempts to improve quality. Finally, the technical report was extensively reviewed by five participants to ensure its accuracy.

ORGANIZATION BACKGROUND

The organization under study was a large multinational firm. The area selected for re-engineering was at the very heart of the organization: the corporate accounting process for all of the United States. This process included 33 application systems responsible for internal business functions such as client billing, inventory, sales commissions, and so forth. All (approximately 1,000) of the firm's U.S. branches depended on at least some of the information processed at the data center. Each business unit developed and maintained its own applications and then contracted with the data processing center to actually run the applications on a day-to-day basis.

The activity was an ideal candidate for re-engineering. Most of the business processes and supporting software had been originally developed in the early 1960s and had gradually grown as business requirements and technology changed. The processes and software were no longer being used as originally intended and designed, but had undergone a long series of uncoordinated, incremental improvements. No clear overall process design had been undertaken in 25 years and many of the original constraints had been overcome with technology--so this project might better be termed process engineering rather than re-engineering. Although databases were developed, they were merely conversions of the earlier flat file structures.

The center had two types of software: the interactive "real-time" database update programs and the "batch" programs. All programs ran under Advanced Administrative System (AAS), an assembly language-based product originally developed in 1960s that prevents real-time and batch jobs from being executed at the same time. Thus,

the data center operated in two modes, providing real-time access for all branch offices and sales/service staff in the United States during normal business hours and running batch reconciliation jobs during the night and on weekends. Approximately 27,000 jobs were run per month across the 33 applications. Although the hardware was continuously upgraded to state of the art, the software and procedures were not.

In the year prior to this study, the center launched a major initiative to improve quality in this process; the objective was to reduce the number of processing errors to a defect rate of Six Sigma (successful completion rate of 99.9997 percent)[10, 11]. After several months of error analysis and planning, new operating procedures were introduced. The successful completion rate steadily increased until it reached a plateau at 99.96 percent--or just over three sigma. While this was impressive, it was still more than 100 times the target error rate. The center decided that, to achieve the target error rate, it had to radically redesign its business processes.

Our re-engineering effort quickly focused on one 40-person unit within the center, Application Support (AS). The AS group was the intermediary between the application owner and the operations group that actually executed the jobs within each application system. The major responsibilities of AS included scheduling and rescheduling jobs, verifying that jobs ran successfully, and solving problems that occur. Since the applications included customer billing, commissions, and so on, there was strong pressure for verification of transaction control totals. Many of the functions that the AS staff performed were designed to provide audit information. Standard operating procedures were sufficiently complicated that there was some suspicion that these reconciliation steps might be causing more problems than they prevented.

PROJECT ACTIVITIES

In this section we describe the pilot project with AS in terms of the phases outlined in the Enterprise Analyzer Methodology. Figure 2 displays the timeline of the meetings and phases of the project. (Figure 2 omitted)

PHASE 1: PREPARATION

A planning meeting with leaders from the data center was used to elucidate the goals of the project and the types of objects (entities) that should be included in the model. Each object type was then defined in the repository with as many validation and index requirements as seemed useful. One application was selected to focus the discussions and all modeling was done from that application's perspective. Participants included those AS staff members involved in any way with that application, as well as managers from affected organizations including the application owner.

The prototyping features of the repository platform were used to create template model editor programs, including data entry screens, for generic object types such as processes, data elements, and relationships. The model object editor programs were then customized from our template programs to capture the terminology and information needed by AS.

PHASE 2: ENTERPRISE MODELING

The first step was to identify current problems and critical success factors (CSFs) (the AS mission was clearly stated in an initial briefing), and AS management viewed assumptions and constraints as superfluous. GroupSystems tools were used for both steps. Participants first brainstormed using an interactive process solely electronic communication) to address the question, "What are the key problems and issues that you face on a day-to-day basis (including weekend, month-end, and year-end processes?" Then the GroupSystems Idea Organizer (IO) tool was run in a chauffeured mode to consolidate these problems into a narrow set of CSFs that could be used to gauge the success of any modifications resulting from our sessions. The group settled on ten CSFs that were rank-ordered by importance.

The second and most substantial step was creating the process model. The first step was identifying the high-level processes that characterize the application being studied. This was accomplished by using IO in a chauffeured mode. Each process was classified as either "as required" or "routine." Within those two classifications, the group generated four and six processes, respectively.

The group of 15 participants was then divided into four subgroups of three or four participants, based on area(s) of the participant's previous experience, with each subgroup assigned specific processes to describe and decompose. The session leader first led the entire group through the definition and decomposition of one of the high-level processes, before letting the subgroups work independently on process decomposition, to improve the likelihood

that all subgroups would work in a consistent manner. Deciding how far to decompose processes is difficult. Our guideline was that they should decompose a process until they began duplicating existing documentation. The focus was on "what" processes did, not the exact details of "how" they did it.

The subgroups worked for about two hours before the session leader called them together to validate one of the decomposed processes. Although many attributes had been interpreted consistently among the subgroups, the "owner" attribute of a process was interpreted differently by two subgroups. Also, some subgroups decomposed processes in much greater detail than others. Following the discussion, the group again broke into subgroups to refine areas to be more consistent with the general interpretation of the meaning of the process attribute and to complete the decomposition of their assigned processes. This cycle of (1) subgroup assignment, (2) group tutoring, (3) subgroup work, (4) group review, and (5) subgroup refinement and subgroup work improved the consistent use of terminology and methods among each of the subgroups.

The other entities in the enterprise model were organizations and applications. Organizations are recognized areas of responsibility (e.g., service level management). The list of 33 applications that make up Application Support was supplied by one of the project leaders, then reviewed and consolidated by the group.

Enterprise Matrix was used to establish the relationships among people or organizations and processes in a responsibility matrix. The available relationships (all mutually exclusive) were (1) primary responsibility, (2) supporting role, (3) exceptional involvement, and (4) other. The project leader described the terminology, then the session leader worked through one complete column with the group as a unit to improve the consistent use of terminology after the group was divided into subgroups. The session leader navigated each cell of the matrix to review the responsibility matrix, creating a relatively tedious process since the group had spent the training period together and used the terminology consistently.

A second matrix modeling the information flows among processes and processes/organizations/applications was then completed. Unlike the first matrix, the relationships in the information flow matrix were not mutually exclusive: (1) sends data to,(2) sends control to, (3) sends status to, (4) receives data from, (5) receives control from, and (6) receives status from. After all the subgroups completed their assigned sections, a group review of the information revealed that all of the subgroups had not interpreted the terminology in a consistent manner. After spending some time trying to resolve conflicts, the group agreed that the project leader could review the remainder after the meeting.

PHASE 3: REDESIGN

The creative stage consisted of three steps in which the group used a combination of GroupSystems tools (mostly the brainstorming tool called Topic Commenter) for "soft" thinking, "hard" thinking, and proposal filtering.

We began with soft thinking, with the objective of having participants think about familiar things in an unconventional manner. The first step was developing metaphors to describe how application support would be described today, and how it could be in ideal circumstances. The rest of the soft thinking step used what-if games and breaking assumptions (see Table 2).

The next step was hard thinking. The group was provided with the process model in three formats (text, matrix, and graphical). All members first identified ways to eliminate each and every process, and the benefits that would occur from doing so. No process was to be spared, and every member had to provide at least one idea; the objective was to require all participants to generate ideas to meet the needs. Next, they identified ways to reduce the number of people involved in each process in order to achieve better levels of coupling and cohesion for the processes. The participants identified candidates for eliminating involvement with potentially high payoffs and proposed ways of eliminating them. Finally, participants identified ways to eliminate information flows.

These two steps resulted in more than 50 single-spaced pages of ideas. The final step was to organize and filter the ideas into a set of specific proposals for change. Using IO and then a group writing tool, the group produced a set of proposals summarized in Table 3. This step proved crucial in the overall project. Many of what the research team considered radical ideas were eliminated in this filtering step (e.g., eliminating legal contracts between the firm's own departments, letting the "customer" department play a larger role in prioritizing and scheduling applications). Some of these ideas were never proposed to become part of the change proposal, but others were raised by some member(s) of the group. During group discussion, senior members of the group objected to their inclusion, saying they were not "practical" or would "never be accepted" by more senior managers.

PHASE 4: IMPLEMENTATION

Shortly after the project meetings were completed, the data center was involved in a large-scale strategic reorganization. The data center is no longer part of the company, but is now part of a subsidiary. Since many of the assumptions behind the proposals were no longer valid, the project was suspended before any of the proposals could be implemented.

ANALYSIS

PROJECT EVALUATION

The evaluation of the methodology, tools, and ideas proposed is based on data from a variety of sources, including observation, questionnaires, debriefing of participants using the EMS, and interviews.

ENTERPRISE ANALYZER METHODOLOGY

Table 4 summarizes questionnaire results evaluating the methodology. (Table 4 omitted) Overall, participants rated the methodology as being effective, efficient, and satisfying. The participants rated the effectiveness of the methodology at generating ideas particularly highly.

The participants comments supported the questionnaire results. For example:

The DSC [Decision Support Center, the EMS meeting room] allowed a free and uninhibited flow of information....I think we got a lot of information that we normally wouldn't have if this were done during a [regular] meeting."

And:

The automated on-line tools were a great improvement over hand written methods of gathering brainstorming data.

The participants' only area of concern with the methodology itself was the amount of their time required, which was exacerbated by the need to perform regular business tasks throughout the meeting days:

The quality of meetings was enhanced. However, I think a hindrance to the quality maybe the length of time it took to get us to this point.

And:

With running the business the primary focus, many people couldn't/didn't attend.

Their input could have been quite valuable.

And:

Maybe we should have been away from the office....Too many interactions, too many other things due.

One measure of output is the number of pages of documentation or ideas. Another measure for the idea generation activities is the number of proposals generated by the activity. These proposals were analyzed by the center's project leader to establish the phase in which the idea was conceived. Many of the final 15 proposals (see Table 3) evolved throughout several activities and thus they can be attributed to several activities. For example, one part of the proposal may have come from the "What If Games" while another part came from the Information Flow Analysis and thus can be counted in both places. An analysis of the results show that a majority of the ideas were conceived during the "hard" phase.

TOOLS

Table 5 summarizes questionnaire responses to questions concerning how well participants perceived each tool to fit the methodology. In general, the tools were very well received and thought to be effective. While all tools received positive evaluations, the new tools developed specially for the EA process (Model Object Editor, Enterprise Matrix, Group Writer) received lower ratings than did the standard GroupSystems tools (Electronic Brainstorming, Topic Commenter, Idea Organizer). There are at least two plausible explanations. First, these were new "Beta test" tools;

the participants encountered several bugs and the user interfaces were not yet consistent with the other tools. Second, the tools and the activities they supported required the participants to spend more time learning than the standard DSC tools with which they were familiar: "Learning new software slowed the process some." If participants were less comfortable with the tools. they may have rated them lower.

PROPOSALS

In general, participants perceived the proposals to be effective and were satisfied with them. Participants also noted that participation in the project promoted organization learning. The questionnaire results suggest that participants gained a greater understanding of Application Support. Interviews support this conclusion and suggest that participants also gained knowledge of other areas with the company: "I became aware of the people that are my peers through this project. It gave me more insight into what motivates the people that I interact with on a day to day basis."

The goal of re-engineering is to find radical ideas. However, the list of proposals produced by the group had a mixture of both radical and incremental improvement ideas, with about twice as many incremental as radical ideas. Interviews with the project manager and the manager's subordinates suggested that the incremental ideas on the list were not "new" per se. They had either been proposed during the previous improvement efforts (and either turned down or postponed due to their expense) or had recently come up in casual discussions (but had not been widely discussed or formally proposed).

The data center manager was rather disappointed with the list of proposals for two reasons. First, he commented that many ideas were not new or radical, but were previously proposed incremental ideas that had originally been turned down. The manager's second concern was that many of the new, radical ideas were too expensive or too risky to implement. They were, in essence, too radical.

Why were the ideas proposed mostly "old" incremental ideas? One interpretation is that despite the creativity techniques used, the group failed to generate new radical ideas, but instead simply restated existing ideas. The project manager and the research team formally examined the meeting transcripts in detail to seek evidence to support this interpretation. We found none.

Many unusual, new, radical ideas were in fact generated. They simply did not pass the filtering step and make it into the final set of proposals. During the proposal filtering stage, many ideas were explicitly rejected by the participants as being too radical, too costly, or outside the scope of the project. We believe two forces were at work.

First, we believe that group members were unsure of the scope of the project and the commitment of senior managers to radical change. Despite senior managers' statements asking for radical ideas, we believe that participants were not fully convinced. The senior members of the project group chose to err on the conservative side by selecting less radical, more incremental ideas. Rather than take a risk and propose very innovative ideas, they tried to steer a safer course--one that backfired, since senior management really did want radical ideas.

Second, we believe that the middle managers that formed the core of the re-engineering team lacked the vision of senior management, who might have been better able to propose radical ideas cutting across organizational boundaries. These participants were more likely to view current policies and interorganizational relationships as fixed constraints that could not be really changed. While they were able to relax these constraints during brainstorming and the creativity exercises, they were unable to truly believe that these constraints could be broken and thus filtered out the more radical ideas as they were drafting their proposals for action.

IMPROVING THE METHODOLOGY

Interviews with participants and our analysis indicated at least five areas for improvement. First and foremost, more time and effort must be devoted by senior managers. It is essential to actively communicate the nature of the organizational commitment to the re-engineering team and present a clear and common understanding of the scope of the project. This was done at the start of the project by the project leader, a middle-level manager, but this proved insufficient. We believe that participants were unsure of senior management commitment, and thus many radical ideas were filtered out. Had the scope and commitment been defined, and actively and enthusiastically communicated by the executive sponsor, the data center manager, and had this manager and other senior managers actively participated in the project, the results might have been different. If they had been active participants, the more radical ideas might not have been filtered out, and the senior managers might have had a better understanding of the rationale behind some of the more expensive and risky radical ideas and been more

receptive to them.

Second, the desired level of process decomposition needs to be defined very clearly at the beginning of the enterprise modeling phase. It has been argued that the primary benefit of the process model is the knowledge gained in building it, not the model itself[7]. We encouraged participants to focus on the "what" of the model (broad general statements), not the "how" (detailed step-by-step descriptions). However, the participants still attempted to provide very detailed descriptions with every single exception documented. Even with continued reminders that the model was going to be discarded, participants still found it extremely difficult to accept a less than perfectly complete model.

Third, the entire group reviewed the work done in the subgroups to identify inconsistencies in definitions and assumptions, as well as content. Despite several examples, and general agreement. on terms, subgroups did adopt different interpretations. This suggests that the progress of the group during each session needs to be monitored periodically to ensure that the group is working towards the same goal. We suggest an "expert floater,"--a person who circulates among the teams and ensures that each team has a consistent understanding of the task goals and terminology.

Fourth, this review of processes and relations by the entire group took a substantial amount of project time. Much of it was spent correcting or accommodating minor differences in opinions or special cases, which in retrospect added little. Again it proved extremely difficult to have the group accept a model with minor inconsistencies. This process was essentially verbal, and thus very time-consuming. We propose that an alternative work room, such as a project office, which has a few workstations to access the EA model can allow participants to review the information at their convenience and their own pace. Such support would allow the group to concentrate on activities that require the interaction among the meeting participants during the time spent at the DSC.

Finally, a formal process for evaluating the group's proposals is needed. This should include a complete stakeholder analysis aimed at evaluating the proposals to determine the support needed from management and other applications. Also, a model of the re-engineered process needs to be built so that the group can evaluate the impact of the proposed changes in the organization.

CONCLUSION

We believe that this pilot project was a success from a research perspective. The project demonstrated that the EA tools and methodology were extensible and flexible, and could be used to support re-engineering of a business process at the very core of a large multinational firm, a process that had been extensively improved using TQM techniques before the project was undertaken.

The project's value to the organization is less clear. Participants gained a better understanding of the structure of the process and produced fifteen proposals for change. While the proposals were potentially valuable, they were not implemented, due in part to the major reorganization and in part to the participants' unwillingness to propose radical changes to senior management. Ironically, if this area had not been part of the first wave of reorganization, the participants might have been encouraged by sweeping changes elsewhere in the organization. One might say the project was a success that failed.

TABLE 1 THE ENTERPRISE ANALYZER PROCESS

1. Preparation

1.1. Establish climate for change

1.2. Develop the vision

* Set project scope and goals

* Establish commitment

* Staff the teams

1.3. Meta Modeling

* Define enterprise model objects

* Define possible relationships

2. Enterprise Modeling

2.1. Define enterprise goals and constraints

* Identify current problems and issues

* Identify mission and critical success factors

* Identify fundamental assumptions and constraints

2.2. Create process model

* Define business processes

* Define people/organizations' involvement with processes

* Define information flows among people/organizations and processes

3. Redesign

3.1. Free-form creative ("Soft") Thinking

* Metaphorical Thinking

* What-if games

* Breaking fundamental assumptions

3.2. Rational analytic ("Hard") Analytical Thinking

* Eliminating processes

* Reducing involvements

* Cutting information flows

3.3. Develop proposals for change

* Organize and filter ideas

* Rank and select ideas

* Refine ideas into proposals

4. Implementation

4.1. Select proposals for immediate action

4.2. Pilot test and evaluate

TABLE 2 SOFT THINKING

1. Metaphorical Thinking

a. Make metaphors of the situation today

b. Make metaphors of the desired situation

c. What is the ideal system

2. What-If Games

The objective of What-If Games is to challenge the basic assumptions held about the business and how it should be conducted. These are examples from the Application Support Case

a. What if Application Support had three people?

b. What if Application Support had 300 people?

c. What if batch processing took 10 seconds?

d. What if batch processing took two days?

e. What if batch processing was done during the day?

f. What if batch processing was never run?

g. What if batch processing never ran without error?

h. What if we could predict each job's outcome?

i. What if everyone could do everyone else's job?

j. What if fixing all errors took 10 seconds?

k. What if there never were any errors?

l. What if everyone did their job perfectly?

m. What if Application Support was paid based on the error rate?

n. What if all processing was done in real time?

TABLE 3 SUMMARY OF PROPOSALS

1. Increase Automatic Balancing of Jobs

2. Career Path Changes and Function Realignment

3. Simplify Management structure

4. "Real Time" available almost 24 hours/day

5. Maintain Shadow Sites for Fast Disaster Recovery and Continuous Availability

6. Simplify Price Update Mechanism

7. Automated Problem Determination and Recovery Management

8. Wideband Data Transmission Enhancements

9. Automate JCL Maintenance Requests

10. Evolution of Service Level Management

11. Make Security (RACF) an Owner Responsibility

12. Automate Job Setup and Scheduling

13. Status Report Enhancements

14. Revise Meetings

15. ATRS Enhancements

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